A.D. 1868, 27th August. N° 2663.

SPECIFICATION

OF

DILLWYN SMITH.

SMOKE-CONSUMING APPARATUS.

LONDON:
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1869.

A.D. 1868, 27th *August*. N° 2663.

Smoke-consuming Apparatus.

LETTERS PATENT to Dillwyn Smith, of Burlington, New Jersey, United States of America, now of No. 8, Southampton Buildings, Chancery Lane, in the County of Middlesex, Gentleman, for the Invention of "Improvements in Smoke-consuming Apparatus."

Sealed the 26th February 1868, and dated the 27th August 1868.

PROVISIONAL SPECIFICATION left by the said Dillwyn Smith at the Office of the Commissioners of Patents, with his Petition, on the 27th August 1868.

I, Dillwyn Smith, of Burlington, New Jersey, United States of America, now of No. 8, Southampton Buildings, Chancery Lane, in the County of Middlesex, Gentleman, do hereby declare the nature of the said Invention for "Improvements in Smoke-consuming Apparatus," to be as follows:—

My Invention relates to a simple, cheap, and convenient method of providing the furnaces of steam boilers and other furnaces with apparatus for burning smoke and other products arising from the combustion of the fuel, and one of the objects of the said Invention is to so construct such an apparatus that the same may be applied to any furnace or fire-grate without disturbing the brickwork or any other part of the structure. Hitherto the application of any smoke-consuming apparatus to furnaces has been attended with so much inconvenience and the beneficial effect produced by such apparatus has been so slight that the general use of means for consuming the smoke in such furnaces has been prevented, and the ill effects arising from the escape of smoke and other products of combustion, and the waste arising from the imperfect combustion of the fuel are still very great.

My improved apparatus is so constructed that it can be readily adapted to a furnace of any size, and can be applied to the furnace of a steam engine or other furnace of a factory or workshop without disturbing the structure, or without hindering the work carried on in such factory.

In the construction of my apparatus two horizontal bars, each in one or more pieces, are made to rest upon the existing dead plates which support the ordinary furnace bars. These two bars are made rather deeper than such furnace bars and extend the entire length of the furnace. The said horizontal bars support a number of cross bars formed and arranged with apertures or spaces between them for the admission of air, or these cross bars may be made hollow to admit air through them. The cross bars are made of any suitable shape, but I prefer to make them of a triangular or V form with feet resting upon the two horizontal bars. I prefer that these cross bars should be made singly or separately, but if desired a number of them may be cast together. The said bars may be made of cast iron or of fire-clay, plumbago, or other fire-resisting material. When made of iron I prefer to make them of a section resembling that of ordinary fire-bars, that is, broad on the surface exposed to the fire and narrow at the other edge. The upper part or apex of these triangular bars and the feet are made thicker than the other parts of the bar, or otherwise suitably formed to keep the central parts of the bar forming the principal air passages slightly apart. Inside these cross bars on each of the sloping sides I prefer to arrange perforated plates. These plates are preferably formed of two sheets or plates of sheet iron perforated with small holes fixed on a frame with a space between them. The said plates extend from end to end of the series of cross bars, and prevent any danger of displacing the said bars in raking the fire or introducing fuel into the furnace. If the perforated plates should become clogged or choked with ashes or fine cinders they can be readily drawn out endwise from the apparatus and freed from the obstructive particles by shaking or other like simple means.

It will be readily understood from the foregoing description of my apparatus that the air enters the same from the ash-pit through the open space between the longitudinal bars, and is thence uniformly distributed through the series of cross bars and perforated plates into the fuel throughout the entire length of the furnace. In some cases however I admit it at one or both ends of the series of cross bars. To ensure a more perfect uniformity in the supply of air to all parts of the furnace I provide the apparatus with draw plates, which are fitted to slide in grooves or upon shoulders extending lengthwise along the interior surfaces of the vertical part of the longitudinal bars, and are formed at the end with flanges whereby the mouth of the ash-pit may be entirely closed if desired. I prefer to employ three of these plates arranged one below the other. The first plate is placed a short distance below the top of the bars and is made to extend about one-third the length of the furnace; the air admitted above this plate enters the front part of the furnace. The second plate extends about two-thirds the length of the furnace, and air is admitted between this and the first plate to the intermediate part of the furnace. The third plate is extended to the end or back of the furnace, and air is conducted to the same between this and the second plate. By adjusting the plates the supply of air to any part of the furnace may be increased or diminished at pleasure, or such supply may be entirely stopped by pushing the plates so far inward that their flanges close the aperture at the front of the ash-pit.

In applying my improved apparatus to a furnace after having ascertained the proper length of the horizontal bars, that is, the length between the existing dead plates in the furnace, I make the said bars of that length, I have then only to remove a few of the fire-bars from the central part of the grate and place my apparatus in the space previously occupied by such bars; the apparatus may be conveniently introduced through the furnace doors. It is therefore obvious that no part of the structure need be disturbed or injured, and that it will not be necessary to let the furnace cool. Thus the loss of time, expense, and other inconveniences usually attending the application of any additional apparatus to a furnace or boiler is entirely avoided, the combustion of fuel in the said furnace is improved, and the nuisance arising from the escape of smoke is entirely prevented. Instead of arranging the cross bars and perforated plates in the centre of the furnace the same may be arranged at one or both sides of the said furnace. I sometimes use perforated hollow bars or tubes which may be placed in the centre of the furnace instead of the two horizontal bars.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Dillwyn Smith in the Great Seal Patent Office on the 27th February 1869.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, Dillwyn Smith, of Burlington, New Jersey, United States of America, now of No. 8, Southampton Buildings, Chancery Lane, in the County of Middlesex, Gentleman, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twenty-seventh day of August, in the year of our Lord One thousand eight hundred and sixty-eight, in the thirty-second year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Dillwyn Smith, Her special licence that I, the said Dillwyn Smith, my executors, administrators, and assigns, or such others as I, the said Dillwyn Smith, my executors, administrators, and assigns, should at any time agree with, and no others from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "Improvements in Smoke-consuming Apparatus," upon the condition (amongst others) that I, the said Dillwyn Smith, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Dillwyn Smith, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement, reference being had to the accompanying Drawings, forming a part of this Specification:—

My Invention relates to a simple, cheap, and convenient method of providing the furnaces of steam boilers and other furnaces with apparatus for effecting the more thorough combustion of both the solid and gaseous portions of the fuel, the objects of the said Invention being to prevent the escape of smoke and other products of combustion, and to so construct such an apparatus that the same may be applied to any furnace or fire-grate without disturbing the brickwork or any other part of the structure. Hitherto the application of what is ordinarily termed smoke-consuming apparatus to furnaces has been attended with great inconvenience without producing the desired beneficial result, consequently the ill effects arising from the escape of smoke and unconsumed gases and the waste arising from the imperfect combustion of the fuel are still very great.

My improved apparatus is so constructed that it can be readily adapted to a furnace of any size, and can be applied to the furnace of a steam engine or other furnace in a factory or workshop without disturbing the structure and without greatly hindering the work carried on in such factory.

In the construction of my apparatus two horizontal or longitudinal bars, each in one or more pieces, are made to rest upon the existing dead plates which support the ordinary furnace bars; these two bars extend the entire length of the furnace, and are preferably made rather deeper than such furnace bars. The said longitudinal bars support a number of cross bars formed and arranged with apertures or spaces between or through them for the admission of air. The cross bars are made of any suitable shape, but I prefer to make them nearly of a U or V form, and to arrange them in an inverted position or with their feet or wide portion resting upon the two longitudinal bars. I prefer that these cross bars should be made singly or separately, but if desired a number of them may be cast together. The said bars may be made of cast iron or of fire-clay, plumbago, or other fire-resisting material. Inside these cross bars I prefer to arrange perforated screens which are preferably formed of two sheets or plates of sheet iron perforated with small holes and fixed on a frame with a space between them. The said screens extend from end to end of the series of cross bars; they aid in heating and more evenly distributing the air which passes through the apparatus, and also prevent any danger of displacing the said bars in raking the fire or introducing fuel into the furnace. If the perforated plates should become clogged or choked with ashes or fine cinders they can be readily drawn out endwise from the apparatus and freed from the obstructive particles by shaking or other like simple means. To ensure a more perfect uniformity in the supply of air to all parts of the furnace I may provide the apparatus with draw plates which are fitted to slide in grooves or upon shoulders extending lengthwise along the interior surfaces of the vertical part of the longitudinal bars, and are formed at the end with flanges whereby the mouth of the apparatus may be entirely closed if desired. I prefer to employ three of these plates arranged one below the other and of different lengths so that they will admit air to different parts of the furnace.

As my Invention is more especially designed to be employed in the furnaces of boilers which are formed with internal flues or tubes I have in the accompanying Drawings shown it in connection with such a boiler, and I will now proceed more fully to describe the said Invention.

DESCRIPTION OF THE DRAWINGS.

Figure 1 is a longitudinal central section of part of a Cornish boiler shewing the furnace thereof fitted with my improved apparatus; Figure 2 is a transverse section on the line *x*, *x*, Figure 1; Figure 3 is an exterior end view of the said furnace; Figure 4 illustrates a modification of part of my Invention; Figures 5, 6, 7, 8, and 9 are detached views drawn to an enlarged scale illustrating the construction of the small transverse bars which form the most essential feature of the said apparatus. Like letters indicate the same parts throughout the Drawings.

A is the internal flue or tube of the boiler, and B is the external shell of the same. The dead plates C and the fire-bars D may be formed in any ordinary and convenient manner. The horizontal or longitudinal bars *a*, as shewn in Figures 2 and 4, are preferably inserted in the centre of the furnace, their upper surface being level with the top of the bars D. The said bars with the plates *b* and bottom plate b^1 extend from the front of the boiler to the back plate *c*, and thus separate the space *d* enclosed between them from the ash-pits d^1. The small transverse or cross bars *e*, which are preferably of cast iron, may be made sectionally like the ordinary longitudinal fire-bars, that is to say, they may be broad on the surface exposed to the fire and narrow on the inner edge, and they may be made with their feet thicker than the intermediate portion, so as to admit the air through the spaces between the said intermediate portions. I however prefer to use bars constructed in the manner illustrated in Figures 5, 6, 7, 8, and 9, as I find them cheap and convenient to manufacture and efficient and durable in use. As shewn in Figure 6 the bars *e* have their sides parallel and are arranged with the surfaces of all of the bars in contact with each other throughout the series. At the sides of these bars I cast the recesses e^2, and when two of the bars are arranged together the recesses of the two adjacent sides of the bars form the holes for the passage of the air, which thus passes in a series of small jets or currents from the space *f* enclosed within the bars *e* into the fuel and the space just above the same, where it is mingled with the combustible gases. The bars *e* being in contact with the burning fuel in the furnace are necessarily kept at a very elevated temperature, and it is obvious that in its passage through the space *f* and through or between the bars *e* the air by coming in contact with the said bars and other parts of the apparatus must acquire a temperature greatly above the ordinary temperature of the atmosphere or what is termed cold air, and that therefore it will not practically lower the temperature of the furnace or require to absorb a large quantity of heat to raise it to the degree of temperature required to produce its combustion or the combination of its particles of oxygen either with the solid carbon or the gases eliminated from the burning fuel. I prefer to make the holes or apertures e^2 conical or taper, as shewn in Figures 5 and 7. I also prefer to make these bars with the outer surfaces e^3 bevilled or reduced to an edge so that the coal lies against a series of ridges between which the air holes open into the spaces or channels e^5. The front end of the series of bars *e* is closed by the plate or block e^*. I find it advantageous to connect the feet e^1 of the transverse bars by a cross piece e^4, as this piece prevents the bending inward or contraction of the bars *e* caused by the unequal heating of their inner and outer edges. I may however construct the bars without the cross pieces e^4. These cross pieces, when used, form a convenient means for supporting the perforated screens *g*, which, as shown in Figure 5, may be inserted inside the series of bars *e*. These screens are formed by securing the thin perforated metal plates or sheets g^1 upon the frame g^2, a space equal to the thickness of the said frame being left between the perforated plates.

In Figures 1 and 2 I have shewn the central compartment or air passage *d* provided with three draw plates *h*, *i*, *j*. The first plate *h* is placed just below the bars D, and is made to extend rather more than a third of the length of the furnace, as shown in Figure 1. The air admitted above this plate enters the front part of the central space enclosed within the bars *e*. The second plate *i* extends about two-thirds of the length of the furnace, and the air is admitted between this and the first plate *h* to the intermediate part of the said central space. The third plate *j* is extended to the end or back of the air passage below the furnace, and air is conducted between this plate and the plate *i* to the rear portion of the central space. By adjusting the plates *h*, *i*, and *j* the supply of air to any part of the furnace through the cross bars *e* may be increased or diminished at pleasure, or such supply may be entirely stopped by pushing the plates so far inward that their flanges h^1, i^1, and j^1, close the front aperture of the air passage or space *d*. It will not be necessary in many cases to use these draw plates, as the admission of the air may be regulated by means of a door or cover *k* placed over the front aperture of the passage *d*, as shewn in Figure 3. Instead of forming the central air passage between the vertical plates *b* fitted in the grooves b^4 in the bars *a*, as shewn in Figure 2, I sometimes form the passage, as shewn in Figure 4, between the adjustable plates b^5, which are hinged or jointed to the bars *a*, and can be extended or spread apart to increase the area of the said air passage as required.

In applying my improved apparatus to a furnace, after having ascertained the proper length for the horizontal bars, that is, the length between the existing dead plates in the furnace, I make the said bars of that length. I have then only to remove a few of the fire-bars D from the central or other convenient part of the grate and place my apparatus in the space previously occupied by such bars. The apparatus may be conveniently introduced through any ordinary furnace doors. It is therefore obvious that no part of the structure need be disturbed or injured, and that it will not be necessary to stop the working of the boiler for a longer time than is necessary for the furnace to cool sufficiently to allow the workman to enter the furnace, and in some cases even this stoppage may not be absolutely necessary. Thus the loss of time, expence, and other inconveniences usually attending the application of any additional apparatus to a furnace or boiler is entirely avoided, the combustion of the fuel in the said furnace is improved, and the nuisance arising from the escape of the smoke is prevented.

Instead of arranging the cross bars and perforated plates in the centre of the furnace the same may be arranged at one or both sides of the said furnace, the cross bars being then made in the form of straight or curved pieces, and arranged to rest against the sides of the furnace or against plates or blocks inserted therein. The cross bars *e* may be made in the form of hollow tubes, or instead of using bars arranged to enclose a space between them, I may employ in the place thereof a series of transverse plates, either solid or hollow, with spaces between them for the admission of the air.

I sometimes use hollow perforated bars or tubes, which may be placed in the centre or other convenient part of the furnace instead of the two horizontal bars *a*. I may also vary my apparatus by placing two or more sets of the horizontal bars and cross bars in a furnace. In some cases I admit air at one or both ends of the series of cross bars. The admission of air to the ash-pits d^1 and grate bars D is regulated by the doors *l*, which are hinged or otherwise attached to the front of the boiler, as seen in Figure 3.

It will be readily understood from the foregoing description of my apparatus that the air which enters the same through the air passage *d* is admitted in the furnace in a number of small jets or streams, and is thereby uniformly distributed and mixed with the solid fuel and gases. I am thus enabled by the use of a simple and durable apparatus to approach nearer than has hitherto been practicable to the desired result of furnishing an adequate supply of oxygen to the hottest part of the furnace in such a manner as to effect the perfect combustion of the carbonaceous and gaseous particles of the fuel therein.

I am aware that mixing air with the fuel and combustible gases of a furnace by admitting the air in small jets or currents is not new, but the apparatus heretofore employed for that purpose has not been constructed in such a manner as to endure for any length of time the intense heat to which it is subjected when placed at the centre of the furnace. Moreover such apparatus has not been heretofore provided with means for restricting the admission of the air thereto, having been used merely as means for augmenting the supply of air while the main portion of the same was still allowed to pass through the grate bars.

Now having thus fully described my said Invention, and shown how the same may be conveniently and advantageously carried into practice, I wish it understood that as above stated I do not claim as my

Invention the method of distributing the air amongst the solid and gaseous contents of the furnace in small jets or streams; but I claim,—

First. The small transverse bars constructed in any convenient form and of any suitable material, and arranged in the centre or other convenient part of the furnace in such a manner as to admit the air thereto in small jets or streams for the purpose set forth.

Second. Constructing these transverse bars in such a manner that when placed together in the furnace they form a central passage or compartment from which the air is distributed between the said bars or through small apertures formed therein, substantially as set forth.

Third. The perforated screens arranged in combination with the bars *e*, substantially as and for the purpose set forth.

Fourth. The central air passage *d* extending from end to end of the ash-pits, and provided with means for regulating the admission of air to the small cross bars *e*, substantially as set forth.

Fifth. The draw plates for regulating the admission of the air to the small cross bars *e* formed and arranged within the central air passage *d*, substantially as set forth.

Sixth. The horizontal bars *a* and small cross bars *e* combined and arranged together and with the central air passage *d*, and with or without the perforated screens *g*, substantially as and for the purpose set forth.

In witness whereof, I, the said Dillwyn Smith, have hereunto set my hand and seal, this Twenty-third day of February, in the year of our Lord One thousand eight hundred and sixty-nine.

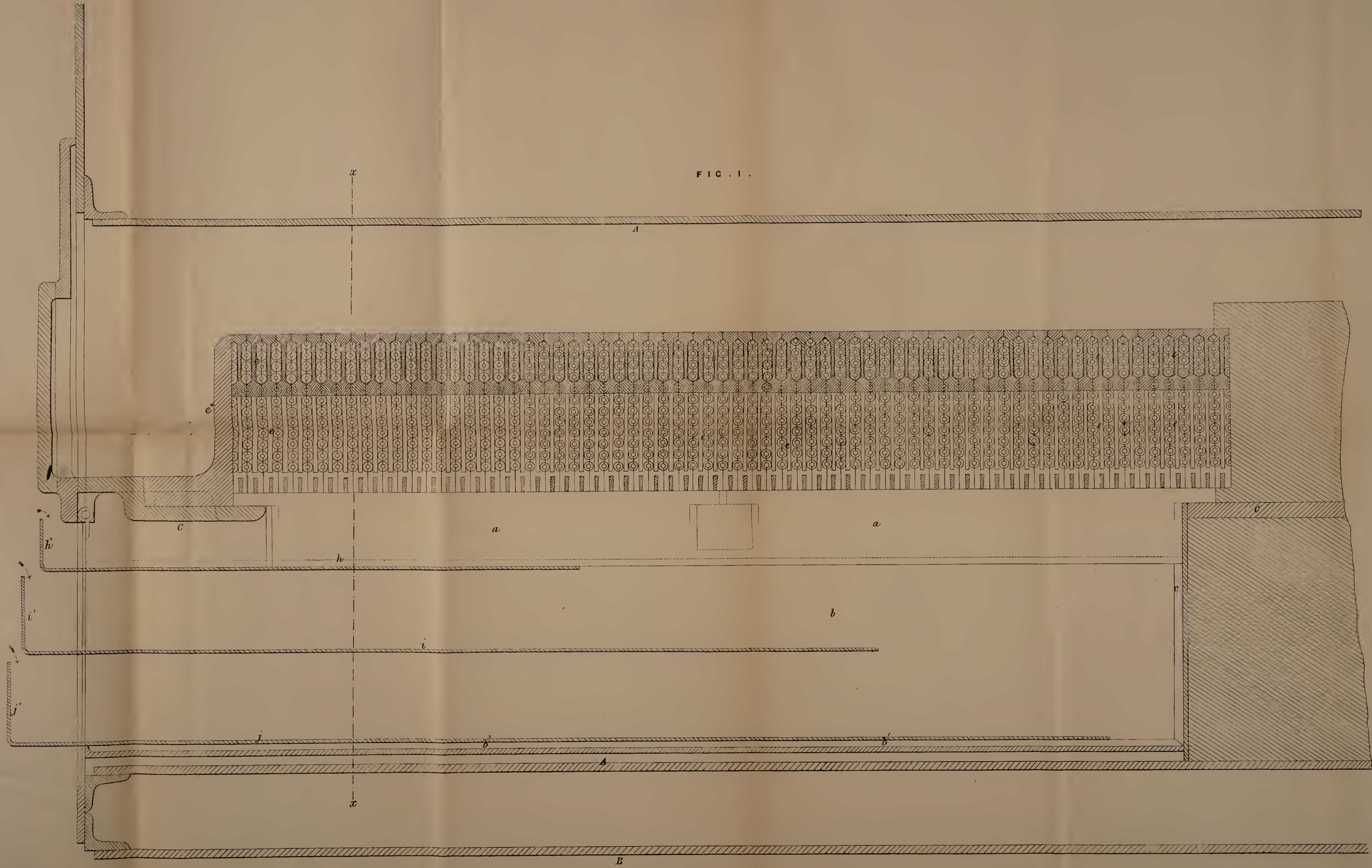
DILLWYN SMITH. (L.S.)

LONDON:
Printed by George Edward Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty. 1869.

A.D. 1868. Aug. 27. No 2663.
SMITH'S Specification.

SHEET 1.
(3 SHEETS)

FIG. 1.



The filed drawing is not coloured.

Drawn on Stone by Malby & Sons.

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FIG. 2.

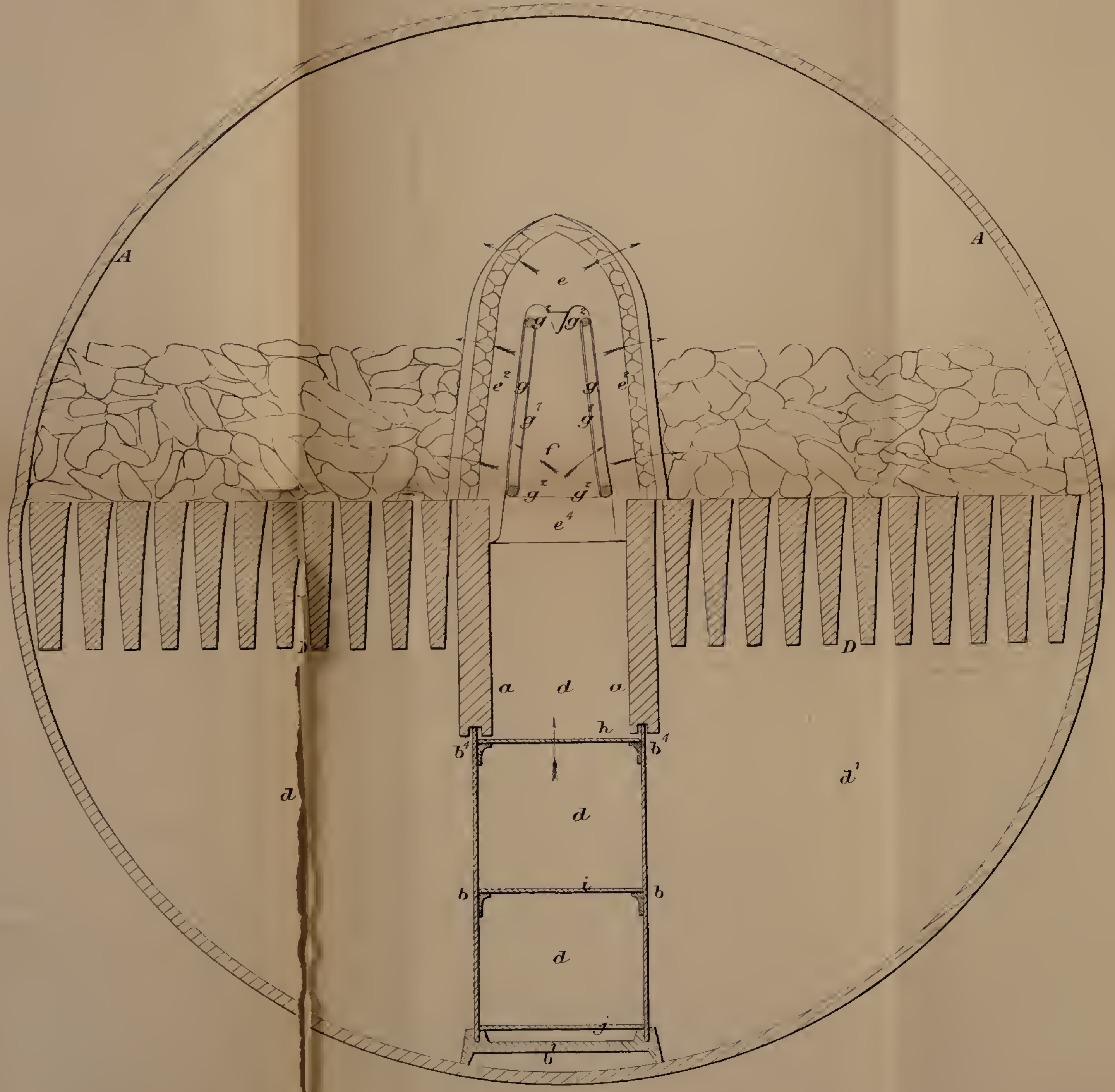
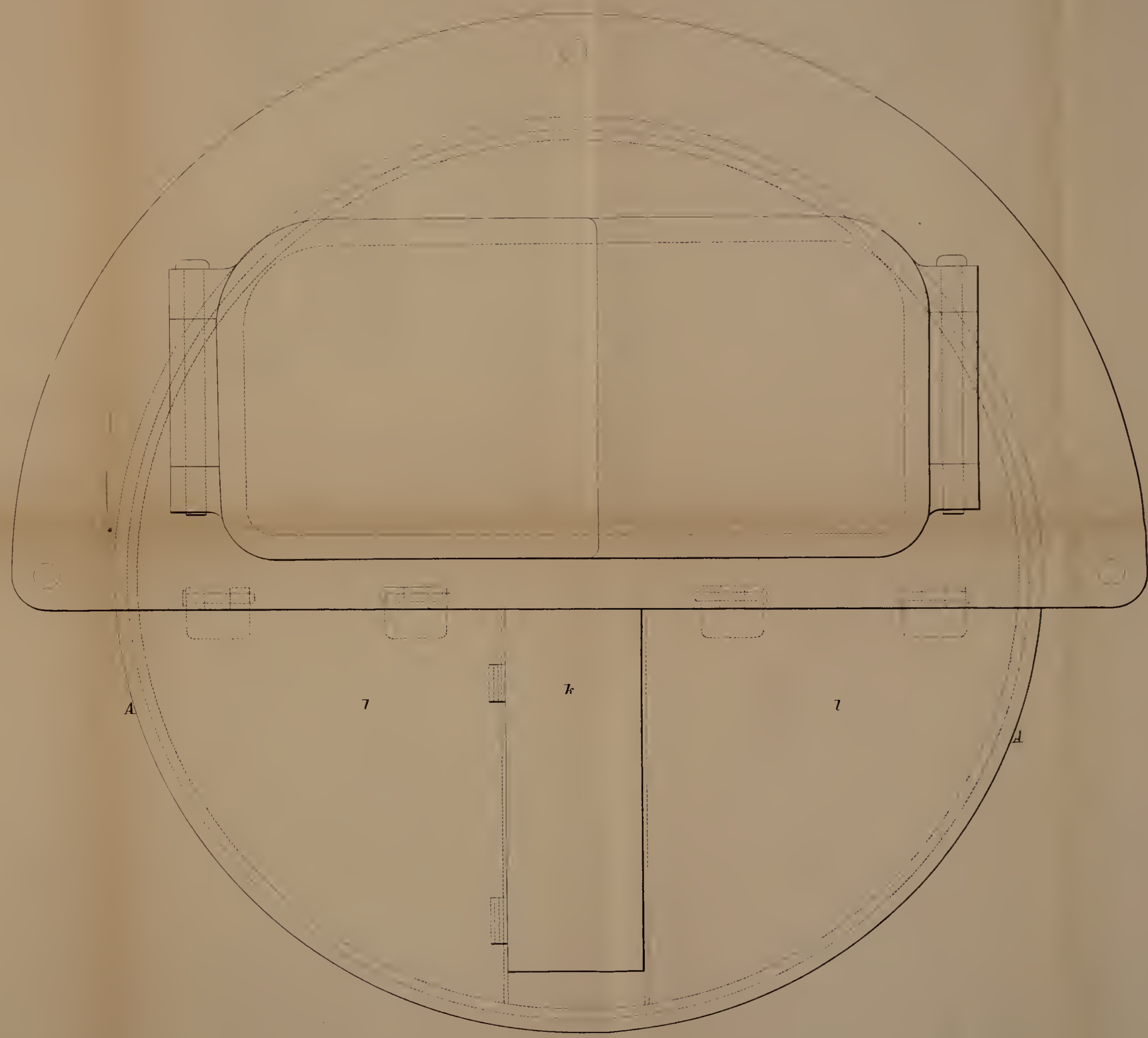


FIG. 3.



The tiled drawing is not colored

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SHEET 3
(3 SHEETS)

FIG. 5.

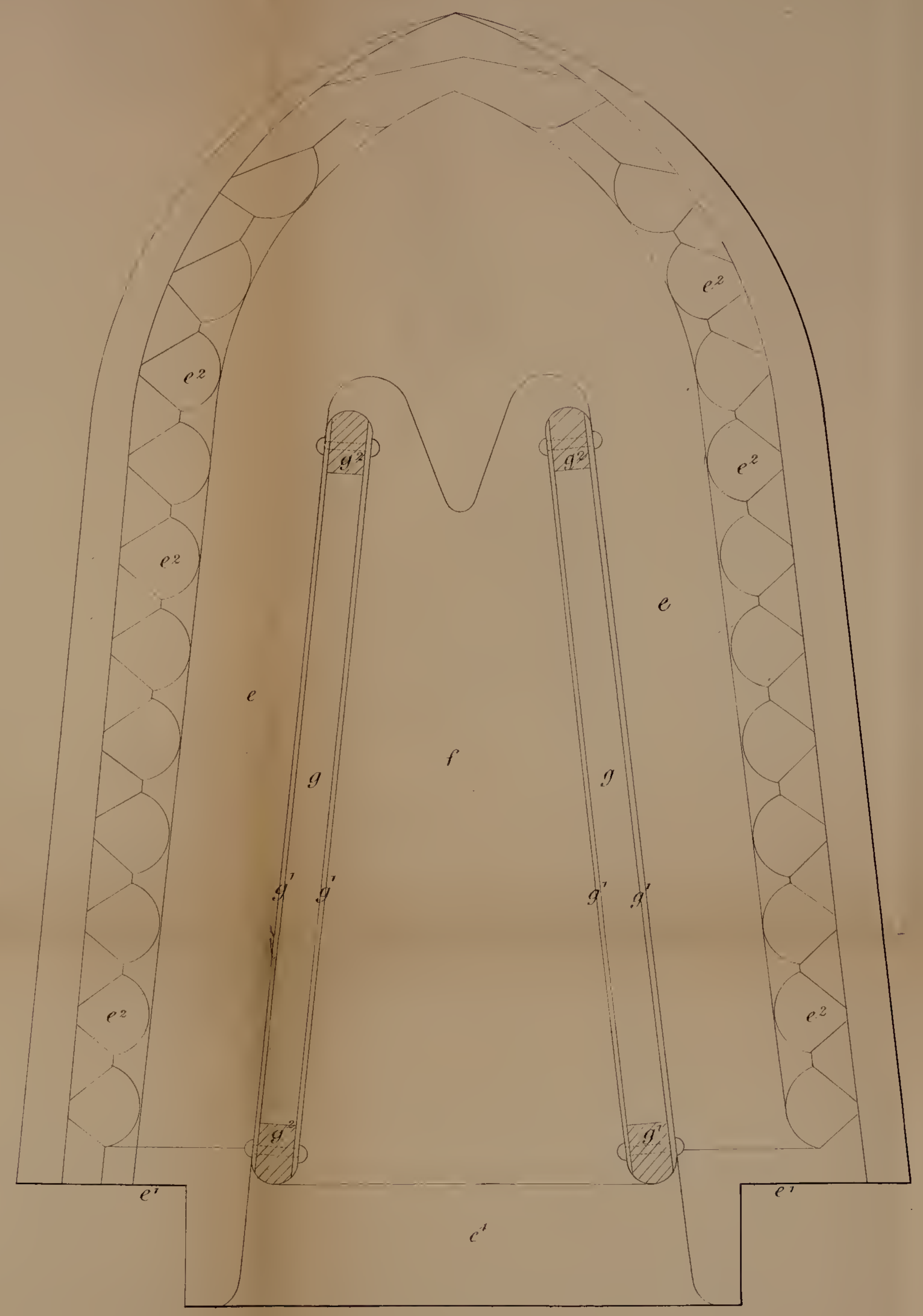


FIG. 6.

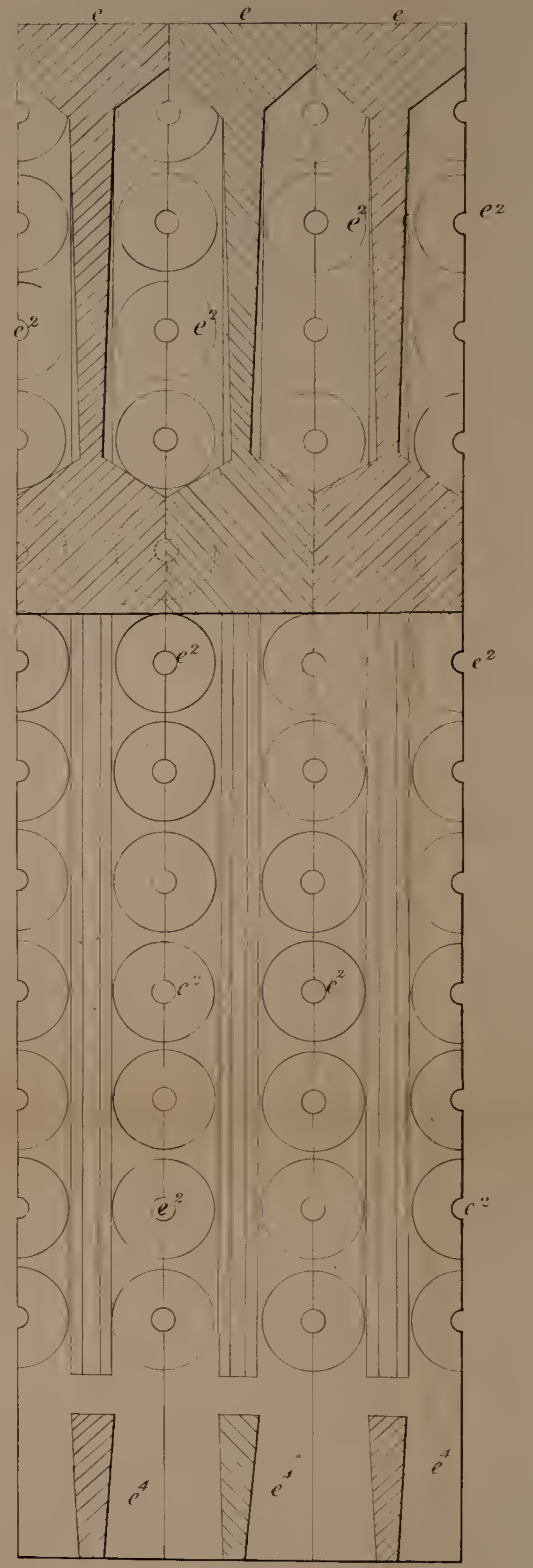


FIG. 4.

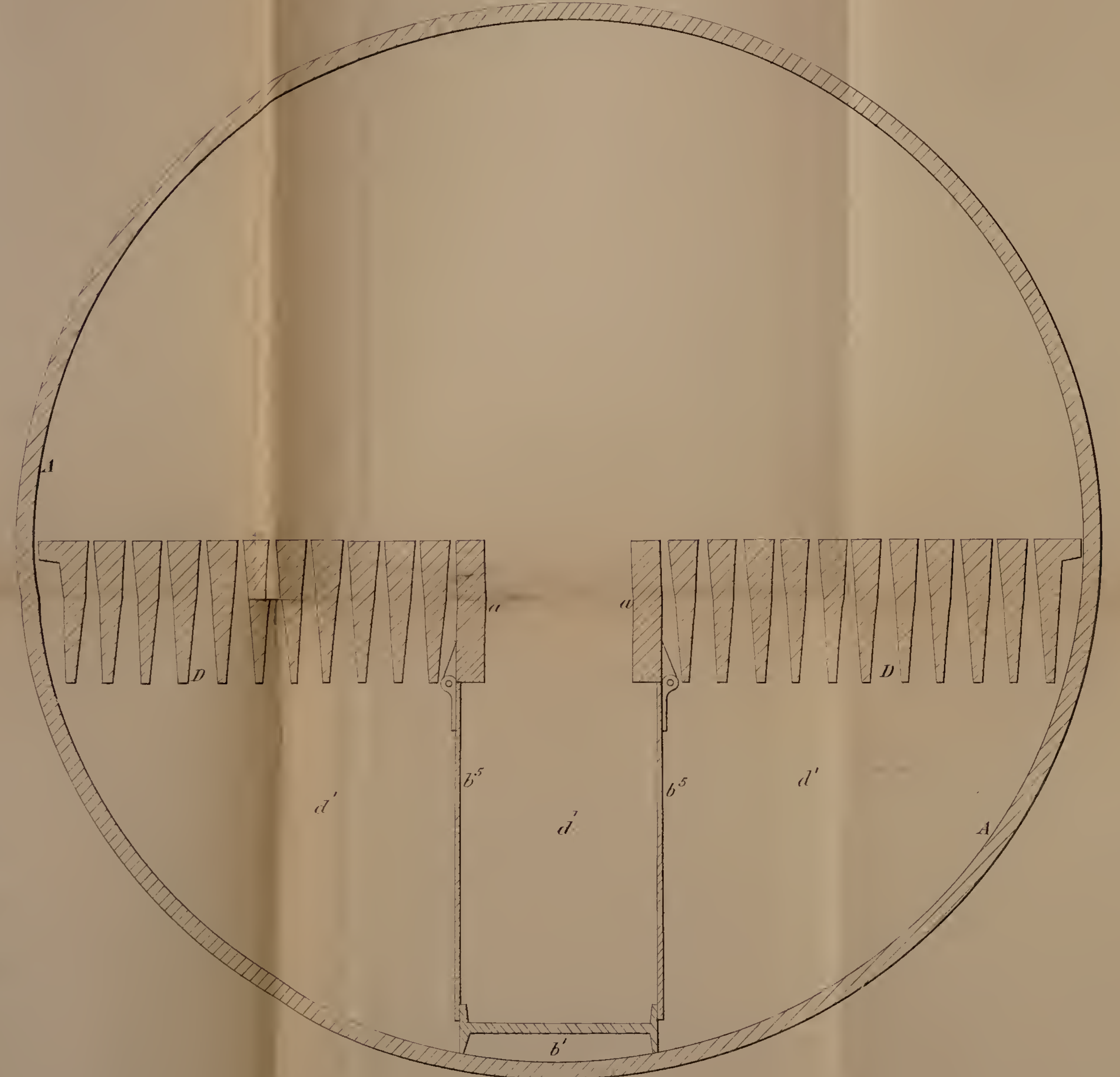
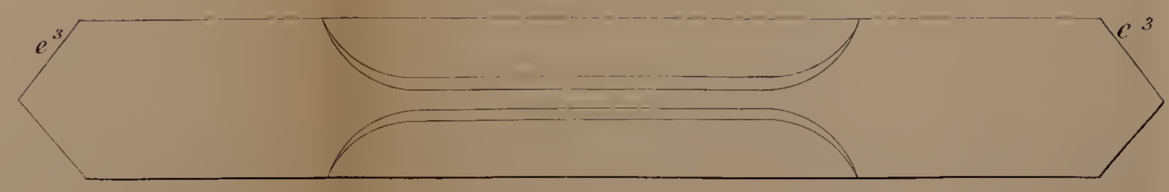


FIG. 7.



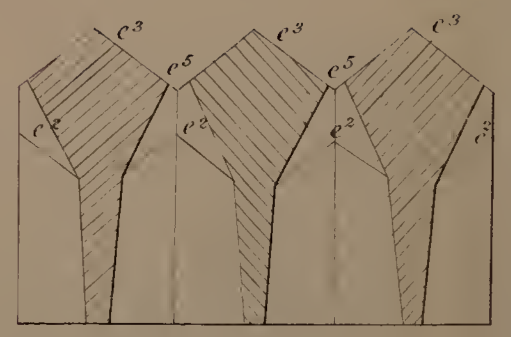
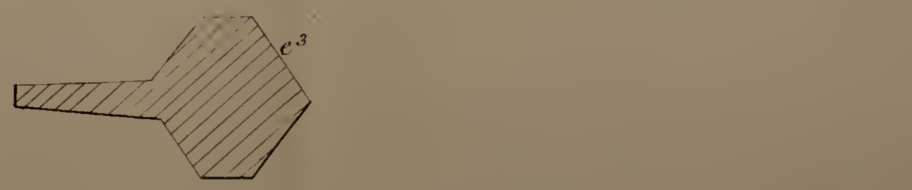


FIG. 8.

FIG. 9.



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